Gelatin-based microribbon hydrogels accelerate cartilage formation by mesenchymal stem cells in 3D.

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Public Summary:
Hydrogels are attractive matrices for cell-based cartilage tissue regeneration given their injectability and ability to fill defects with irregular shapes. However, most hydrogels developed to date often lack cell scale macroporosity, which restrains the encapsulated cells, leading to delayed new extracellular matrix deposition restricted to pericellular regions. Further, tissue engineered cartilage using conventional hydrogels generally suffers from poor mechanical property and fails to restore the load-bearing property of articular cartilage. The goal of this study was to evaluate the potential of macroporous gelatin-based microribbon (microRB) hydrogels as novel 3D matrices for accelerating chondrogenesis and new cartilage formation by human mesenchymal stem cells (MSCs) in 3D with improved mechanical properties. Unlike conventional hydrogels, these microRB hydrogels are inherently macroporous and exhibit cartilage-mimicking shock-absorbing mechanical property. After 21 days of culture, MSC-seeded microRB scaffolds exhibit a 20-fold increase in compressive modulus to 225 kPa, a range that is approaching the level of native cartilage. In contrast, HGs only resulted in a modest increase in compressive modulus of 65 kPa. Compared to conventional hydrogels, macroporous microRB scaffolds significantly increased the total amount of neocartilage produced by MSCs in 3D, with improved interconnectivity and mechanical strength. Together, these results validate gelatin-based muRBs as promising scaffolds for enhancing and accelerating MSC-based cartilage regeneration and may be used to enhance cartilage regeneration using other cell types as well.

Scientific Abstract:
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